the main battery **5**, and an insulated DC-DC converter **4** which receives the link voltage Vlink to supply the power to the load **7**.

[0023] The following is the description about a power flow of the power source device **1** and the electric vehicle **100** at the time of charging, with reference to FIG. **2**. At the time of charging, the insulated AC-DC converter **2** receives the power of the AC power source **10** to output the link voltage Vlink, and the bidirectional DC-DC converter **3** receives the link voltage Vlink to charge the main battery **5**. In addition, in a case where the load **7** consumed the power, the power is supplied from the link voltage Vlink to the load **7** by operating the insulated DC-DC converter **4**. In this way, at the time of charging, the main battery **5** is charged and the power is supplied to the load **7** using the power of the AC power source **10**.

[0024] The following is the description about the power flow of the power source device **1** and the electric vehicle **100** while the vehicle is running, with reference to FIG. **3**. While the vehicle is running, the power is supplied from the main battery **5** to the drive motor **104** through the converter **102** and the inverter **103**. The bidirectional DC-DC converter **3** receives the power of the main battery **5** to output the link voltage Vlink, and the power is supplied from the link voltage Vlink to the load **7** by operating the insulated DC-DC converter **4**. In this way, while the vehicle is running, the power is supplied to the load **7** using the power of the main battery **5**.

[0025] As described above, the power source device **1** of this embodiment includes the bidirectional DC-DC converter **3** between the link voltage Vlink and the main battery **5**. With this configuration, even in a case where a voltage range of the main battery **5** is wide, a voltage range of the link voltage Vlink can be made narrower than that of the main battery **5**.

[0026] At the time of charging in the conventional power source device having no bidirectional DC-DC converter **3**, the insulated AC-DC converter outputs the voltage of the main battery **5**. In general, the efficiency of the converter is easily lowered when the input voltage range is wide, and also the cost is easily increased. Therefore, in a case where the voltage of the main battery **5** is wide, the output voltage range of the insulated AC-DC converter becomes wide. Accordingly, there is a problem in that the efficiency of the insulated AC-DC converter at the time of charging is easily lowered, and also the cost is easily increased.

[0027] In addition, the voltage of the main battery **5** becomes the input voltage of the insulated DC-DC converter while the vehicle is running. Therefore, in a case where the voltage range of the main battery **5** is wide, the input voltage range of the insulated DC-DC converter becomes wide. Accordingly, there is a problem in that the efficiency of the insulated DC-DC converter while the vehicle is running is also lowered, and also the cost is easily increased.

[0028] In this regards, in the power source device **1** of this embodiment, the output voltage range of the insulated AC-DC converter **2** at the time of charging is the voltage range of the link voltage Vlink. In addition, the input voltage range of the insulated DC-DC converter **4** while the vehicle is running is also the voltage range of the link voltage Vlink. As described above, the voltage range of the link voltage Vlink can be narrower than that of the main battery **5**. For this reason, in the power source device **1** of this embodiment, the output voltage range of the insulated AC-DC converter and the input voltage range of the insulated DC-DC converter can be narrower than that in the related art, and a high efficiency and a low cost can be achieved even at the time of charging and running.

Second Embodiment

[0029] FIG. **4** is a circuit diagram illustrating a configuration of a power source device **1***a* according to this embodiment. The power source device **1***a* includes an insulated AC-DC converter **2***a* which receives the power of the AC power source **10** and outputs the link voltage Vlink insulated from the AC power source **10** between nodes Nd**1** and Nd**2**, a bidirectional DC-DC converter **3***a* which receives the link voltage Vlink to charge the main battery **5**, an insulated DC-DC converter **4***a* which receives the link voltage Vlink to supply the power to the load **7**, and a control unit **11** which controls these converters.

[0030] The insulated AC-DC converter **2***a* includes an AC-DC circuit **8***a* which receives the voltage of the AC power source **10** to output a DC voltage, and a DC-DC circuit **9***a* which receives the DC voltage output by the AC-DC circuit **8***a* to output the insulated link voltage Vlink.

[0031] In the AC-DC circuit **8***a*, the voltage of the AC power source **10** is full-wave rectified using diodes D**11** to D**14** which are connected in bridge. The full-wave rectified voltage is input to a boosting chopper circuit which is configured by a smoothing inductor L**1**, a switching element Q**10**, a diode D**10**, and a smoothing capacitor C**1**. The AC-DC circuit **8***a* outputs a DC voltage between both ends of the smoothing capacitor C**1**. The control unit **11** performs power factor improvement in which the input current from the AC power source **10** is controlled to be a sinusoidal waveform almost similar to the voltage of the AC power source **10**.

[0032] The DC-DC circuit **9***a* includes a transformer T**1** in which a winding N**1** configured by a resonance capacitor Cr**1** and a resonance inductor Lr**1** connected in series and a winding N**2** are magnetically combined. Herein, the resonance inductor Lr**1** may not be provided in some cases, depending on a leakage inductance and a wiring inductance of the transformer T**1**.

[0033] A rectangular voltage is generated from the voltage input to the smoothing capacitor C**1** using a switching circuit configured by full-bridged switching elements Q**1** to Q**4**. The rectangular voltage is applied to a serial connection body of the resonance capacitor Cr**1**, the resonance inductor Lr**1**, and the winding N**1** to cause a resonance current to flow to the winding N**1**. A current induced in the winding N**2** is rectified by a rectification circuit configured by connecting diodes D**21** to D**24** in bridge, and smoothened by a smoothing capacitor C**2**. Then, the link voltage Vlink is output between the nodes Nd**1** and Nd**2**. Further, diodes D**1** to D**4** are connected to the switching elements Q**1** to Q**4**, respectively.

[0034] In this way, the DC-DC circuit **9***a* forms a resonance converter, and controls the output basically by changing switching frequencies of the switching elements Q**1** to Q**4**.

[0035] The bidirectional DC-DC converter **3***a* includes a smoothing capacitor C**3** connected between terminals Tm**1** and Tm**2**, switching elements Q**5** and Q**6** connected in series between the terminals Tm**1** and Tm**2**, and a smoothing inductor L**2** and a smoothing capacitor C**4** connected in series between both ends of the switching element Q**6**. Both